

# RD&T Today

*From research to reality*

RESEARCH - DEVELOPMENT - TECHNOLOGY TRANSFER

Wisconsin Department of Transportation

November 2000

## CEOs want research on managing change in state DOTs

**R**esponding to “an environment of unprecedented change,” CEOs and members of senior staff from DOTs around the country met in Minneapolis June 25-27 to talk about managing both internal and external change.

Leaders from 35 state DOTs were represented among the 120 attendees, including Secretary Terry Mulcahy and Division Administrators Ernie Wittwer and Dan Pritchard from Wisconsin.

The group generated an ambitious agenda of 26 proposals for what is sometimes called “soft” research, for consideration in the National Cooperative Highway Research Program (NCHRP) and the Transit Cooperative Research Program (TCRP). NCHRP has already developed eight research themes from the CEOs’ proposals.

“The CEOs are on the right track,” says Mike Cass, administrator of the Division of Transportation Infrastructure Development (DTID). “In Wisconsin we are also working to strengthen strategic and process research. We have to learn to operate smarter in a changing environment.”

Here is a brief summary of the research proposals in four key areas. Contact the Research Coordination Section for a full text of the proposals and a PowerPoint summary of the workshop.

### ***Strategic planning research***

Three of the five research proposals in this area are aimed at understanding what users of DOT products and services want and don’t want, how to build support among legislators, and how to mount a comprehensive marketing effort that identifies customer needs, develops strategies and communicates successes back to the customer.

### ***Work force and reorganization research***

Retirements, downsizing and new technologies available for delivering services all impact on state DOT employees. The CEOs propose projects to identify the best private- and public-sector practices in key areas such as employee succession planning and core competencies.

### ***Process and program delivery research***

Outsourcing, managed competition and partnerships with the private sector are the subjects of three research proposals. The CEOs want to know how best to measure the effectiveness

of these new approaches and what barriers there are to increased public/private cooperation.

Streamlining procurement procedures and exploring innovative contracting services are two more pro-



**“The CEOs are on the right track...In Wisconsin we are also working to strengthen strategic and process research. We have to learn to operate smarter in a changing environment.”**

**—Mike Cass, WisDOT DTID Administrator**

posed areas to investigate. Included for scrutiny would be new approaches to project delivery and internal project management processes.

### ***Cross-cutting research***

In this broadest area of proposed research, the CEOs want to open up inquiries in sometimes controversial areas, such as: short- and long-term outlooks for fuel shortages and price spikes; the impacts of alternative-fuel vehicles on petroleum-fuel tax revenues; sharing services and responsibilities with local transportation agencies; and engaging the public in planning transportation projects.

## RD&T Today



*RD&T Today* is published by the Research Coordination Section, Division of

Transportation Infrastructure Development, Wisconsin Department of Transportation.

Our goals include helping identify needed transportation research not previously carried out by others, monitoring research in progress and facilitating implementation of results into practice.

This three-step process of research, development and technology transfer (RD&T) is at the core of all of our activities.

**Terrence D. Mulcahy**

Secretary  
Wisconsin Department  
of Transportation

**Michael A. Cass**

Administrator  
Division of Transportation  
Infrastructure Development

**Nina L. McLawhorn**

Research Administrator  
Research Coordination Section

**Ann Pahnke**

Program Analyst  
Research Coordination Section

**Bonnie Anderson**

Program Analyst  
Research Coordination Section

**Patrick Casey**

Communications Consultant  
Research Coordination Section  
Editor

**Wisconsin Department  
of Transportation**  
4802 Sheboygan Ave., Rm 451  
P.O. Box 7965  
Madison, WI 53707-7965  
Tel 608-266-3199  
Fax 608-264-6667  
rd&t@dot.state.wi.us



**T**he cover story of this issue of *RD&T Today* underscores the important role of research in managing change.

State DOT leaders from around the country, including our own Secretary Terry Mulcahy, devoted two days to a discussion of how to better understand and respond to a changing transportation environment. They came up with 26 research projects to help them address these questions.

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On the *regional* research level, Ernie Wittwer former administrator of the Division of Transportation Infrastructure Management, has become the new director of the University Transportation Center, based at UW-Madison. Ernie shares his enthusiasm for the UTC's future on the back page.

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With the October 1 beginning of the new federal fiscal year (FFY 2001), WisDOT and its partners undertake **20 new research projects** aimed at improving the way we plan, build and operate our transportation systems.

We hope the summaries of these projects on pp. 3-11 will stimulate your interest in following their progress.

On the highway side, under the leadership of Peter Bosscher, director of the Wisconsin Highway Research Program (WHRP), 11 new projects have already begun, after making their way through a careful solicitation and contracting process. Five of these are pooled fund efforts with other states.

## Research Coordination Section

### Nina McLawhorn Research Administrator

We also introduce you to the WisDOT staff who lead the WHRP Technical Oversight Committees (TOCs) and to the other TOC members—from WisDOT, industry and academia—who monitor and evaluate the projects.

In non-highway research, our new Council on Research (COR), pictured on p. 3, has just recently selected four new WisDOT projects and five pooled fund studies for FFY 2001. We hope that all of them will be under contract and in process before the end of the year.

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We look forward to working with

**Steve Krebs,**

WisDOT's new leader of the Pavement Section in the Bureau of Highway Construction. Steve brings with him a wealth of knowledge from his years in the Bureau of Aeronautics.



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Please check the WisDOT Research Section website at **[www.dot.state.wi.us/dtid/research](http://www.dot.state.wi.us/dtid/research)** for recent developments in Wisconsin transportation research and useful links to national sites.

I welcome your suggestions for continuing to improve our research programs. Contact me at any time by phone (608-266-3199) or E-mail ([nina.mclawhorn@dot.state.wi.us](mailto:nina.mclawhorn@dot.state.wi.us)).

*Nina*

## New Council on Research selects projects for coming year

Newly appointed members of WisDOT's restructured Council on Research (COR) met in mid-September and early November to select nine non-highway research projects for Federal Fiscal Year (FFY) 2001, five of which are pooled fund efforts with other states.

COR research may include areas such as operations and strategic planning, urban and modal issues, or environmental and land use questions.

Selections were made from 38 proposals submitted by WisDOT divisions. Ranking criteria included advancement of the department's strategic plan, cost-effectiveness and likelihood of implementation.

"We are very fortunate that COR members not only bring to their deliberations the perspectives of all of the department's divisions

**"...we are well on the way to using research to address the department's strategic needs."**

**—Nina McLawhorn  
Research  
Administrator**

and offices; each COR member also has a seasoned, department-wide perspective," said Nina McLawhorn.

"We reached into every corner of the department to identify needed research. I believe we are well on the way to using research to address the department's strategic needs."

Solicitation for FFY 2002 projects will begin early in 2001 with consideration given to this year's proposals that were not selected.

New proposals will be sought from all of the department's divisions and in additional targeted areas critical to the mission of the department.



**Council on Research members (left to right):** Beverly Larson, Division of Motor Vehicles (DMV); Ron Adams, Division of Transportation Infrastructure Development (DTID); Bonnie Anderson, Research Section Program and Planning Analyst; Nina McLawhorn, Research Administrator; Roman Kyweluk representing Jeff Western, Division of Business Management (DBM); Rod Clark, Division of Transportation Infrastructure Management (DTIM); Dwight McComb, Federal Highway Administration (FHWA); Tony Allard representing Alan Rommel, Division of Transportation Districts (DTD); and Joe Maassen, Executive Offices. Not pictured: Dan McGuire, Department of State Patrol (DSP).

### Too many ways to take your license away?

Title: *Impact on Highway Safety of Multiple Administrative Driver License Withdrawal Systems*  
Submitted by: Division of Motor Vehicles  
Duration of project: 1 year  
Cost of research: \$130,000

Wisconsin has three separate administrative systems for revoking driver licenses. The systems are not easily understood by drivers or easily administered. In addition, the state is considering participation in a fourth (interstate) system, the Driver License Agreement (DLA), that would require consistent application of penalties for out-of-state convictions.

This project will explore alternative approaches that may improve compliance and highway safety.

### What happens when we build a road?

Title: *Economic and Land Use Impacts of the Highway 29 Corridor*  
Submitted by: Division of Transportation Infrastructure Management, Bureau of Planning  
Duration of project: 1 year  
Cost of research: \$70,000

Highway 29 in Wisconsin was the first in the nation to have economic development benefits forecast (in a 1989 study) prior to its expansion from two to four lanes.

This new study will verify whether the expectations are being met now that construction is nearly complete. A more current baseline of economic and land use impacts will also be established for use in coming years.

*More COR projects on pp. 4-5*

## More Council on Research projects for FFY 2001

### **Atlas of Wisconsin Mussels**

Title: *Fresh Water Mussel Study*  
Submitted by: Division of Transportation Infrastructure Development, Bureau of Environment  
Duration of project: 2 years  
Cost of research: \$50,000 (to be added to \$50,000 from DNR and \$50,000 from DOT in FY 2000)

This cooperative project, jointly funded by the Wisconsin Department of Natural Resources, will lay the groundwork for the first ever comprehensive survey of Wisconsin's freshwater mussels, commonly known as clams.

Unlike the smaller, non-native Zebra mussel, which clogs water intake pipes, native mussels are essential for the health of Wisconsin rivers and lakes. They clean the water and serve as a stable food supply for fish and other wildlife.

Eighteen different native mussel species are listed by the state of Wisconsin as endangered or threatened. This means that the Department of Natural Resources and WisDOT must demonstrate that incidental loss of mussels from bridge reconstruction will not jeopardize the survival of the species.

This research will consolidate published and unpublished information on the distribution and relative abundance of Wisconsin's mussels and also identify major geographic areas with bridge crossings that have not been previously surveyed.

The resulting "atlas" and the future complete mussel inventory for the state will greatly reduce the need for time consuming and expensive underwater studies for every proposed bridge project. New information from the inventory may even permit the re-

moval of several species of mussel from the endangered list, saving additional time and money on future transportation projects.

### **How bad is the burnout?**

Title: *Examining Stress Levels of DSP Enforcement Personnel and Intervention Techniques*  
Submitted by: Division of Business Management  
Duration of project: 1 year  
Cost of research: \$60,000

Anecdotal information indicates that law enforcement personnel in WisDOT's Division of State Patrol (DSP) experience high levels of job stress that may be resulting in negative impacts—on services provided to the public and on costs to the department.

This research project will attempt to document and quantify more objectively whether DSP personnel have higher levels of worker's compensation claims, sick leave usage, turnover or early retirement compared to other WisDOT employees and to personnel in other law enforcement agencies.

Potential intervention techniques will also be investigated, such as training programs and outreach to personnel and their families.

Strategies developed for documenting employee stress levels and designing intervention techniques will be available for potential application in other parts of the department.

### **What's a pooled fund?**

Any federal, state, regional or local transportation agency may initiate a pooled fund research study and invite others to contribute to it. The idea is to join forces to solve a common problem.

Participants in a pooled fund project contribute money, talent or other resources to help conduct the research. They may be actively involved, merely attend update meetings or just receive the final report. But they always feel good about helping fund worthwhile research.

Private companies, foundations and universities may also contribute to pooled fund projects or seek partnerships with transportation agencies to initiate a project.

The process for floating out potential projects and soliciting participants is being re-engineered by FHWA. The plan is to establish a website where proposed projects can be posted on a quarterly basis and those interested may register their intent to contribute to it.

For more information and details on all current pooled fund studies, visit the **Turner-Fairbank Highway Research Center** website at: [www.tfhrcc.gov/site/active.htm](http://www.tfhrcc.gov/site/active.htm).



## Council on Research *pooled fund* projects for FFY 2001

(Pooled fund proposals were prioritized by the Council and finalized by division administrators Mike Cass and Ernie Wittwer.)

### **Smarter and safer work zones**

Title: *Midwest States Smart Work Zone Deployment Initiative (MwSWZDI)*

Submitted by: DTID Bureau of Highway Operations

Wisconsin contribution: \$90,000

Other participating states: Iowa, Missouri and Nebraska

New technologies will be tested during the 2001 construction season for their value in improving safety and efficiency in highway construction work zones. Nationally in 1998 there were 772 fatalities and 37,000 injuries in work zones. In Wisconsin, 17 people were killed in work zones in 1999, and 1,200 were injured.

Examples of devices to be tested are portable traffic management systems, speed monitoring displays, CB warning systems and portable rumble strips.

### **High tech snow plows**

Title: *Phase IV Highway Winter Maintenance Concept Vehicle Project*

Submitted by: DTID Bureau of Highway Operations

Wisconsin contribution: \$50,000

Other participating states: Iowa, Minnesota and Michigan

Begun in 1996, this project evaluates enhanced safety and effectiveness of selected snow plows that have been retrofitted with new technologies. Three concept snow plows have been deployed in Wisconsin in previous years with several more slated for this winter.

Technologies include rear-mounted video cameras and metering devices allowing blending of on-board liquid

and solid deicing agents for maximum effectiveness.

### **Better roadside barriers**

Title: *Midwest States Crash Testing Program*

Submitted by: DTID Bureau of Highway Development

Wisconsin contribution: \$55,000

Other participating states: Various, changes each year. Nebraska is the contact state.

In 1994 the Federal Highway Administration issued an executive policy directive mandating the upgrade of substandard roadside safety hardware on the national highway system by late 1998 and subsequent testing of new roadside safety hardware for performance against federal standards.

This research project permits states to join together for testing of prospective hardware and early compliance with federal mandates. Also included is ongoing comparative evaluation of traffic barrier design, construction and maintenance costs.

### **Winter weather trackers**

Title: *Computer-based, Self-operating Training System on Anti-icing/Road Weather Information Systems (AI/RWIS)*

Submitted by: DTID Bureau of Highway Operations

Wisconsin contribution: \$30,000

Other participating states: Various, changes each year. Iowa is the contact.

This project will result in the development of an interactive, customizable, computer-based train-

ing program for using existing Anti-icing/Road Weather Information Systems (AI/RWIS).

These information systems are networks of monitoring stations located along primary roads and at potential trouble spots, such as bridges.

By monitoring air and pavement temperatures to predict whether precipitation will freeze on the pavement, an RWIS allows highway agencies to make more informed decisions about where and when to deploy materials, crew and equipment.

Standard training programs for all types of AI/RWIS users are not currently available.

### **Guide for reducing crashes**

Title: *Development of an Implementation Guide for Unsignalized Intersections*

Submitted by: Division of Transportation Infrastructure Development, Bureau of Highway Operations

Duration of project: 18 months

Wisconsin contribution: \$100,000

Contact: FHWA

Reducing traffic related deaths and injuries at intersections without traffic signals has been identified as a key emphasis area of the Strategic Highway Safety Plan.

This project will help states target crash problem areas, define potential countermeasures, implement strategies and evaluate their effectiveness.

The product of the research will be an implementation guide available to all states and locals in hard copy and electronic format.

# Wisconsin Highway Research Program (WHRP) launches six projects

## Structures Technical Oversight Committee



**Stan Woods**  
TOC Chair

Members: Ed Fitzgerald, WisDOT; Gerry Anderson, WisDOT; Tom Strock, FHWA; Dave Bechthold, Zenith Tech; Mike Hanson, Lunda Construction; Mike Pheifer, Pheifer Brothers Construction; Larry Bank, UW-Madison; Chris Foley, Marquette University; Al Ghorbanpoor, UW-Milwaukee; Bob Wysocki, HNTB

## An electronic guide to best practices

Title: *Rehabilitation Techniques for Concrete Bridges* (0092-01-06)

Investigators: Habib Tabatabai and Al Ghorbanpoor, UW-Milwaukee

Start-end dates: November 2000-May 2003 (30 months)

Cost of research: \$124,968

Wisconsin's many lakes and rivers required construction of more than 13,000 bridges for traffic crossings. Most of the state's bridges are concrete, and nearly half of them are more than sixty years old.

As our bridges deteriorate at an accelerating rate from corrosion, concrete degradation and vehicle damage, WisDOT has the enormous challenge of repairing them—and, where possible, preventing further deterioration.

In addition, older bridges originally built for lower traffic volumes,

smaller vehicles and lighter loads, often need to be modified and strengthened for the traffic of today and the future, as a cost-effective alternative to building replacement structures.

WisDOT currently employs numerous strategies for bridge maintenance and renovation, with guidance given to engineers and maintenance crews in Chapter 40 of the Bridge Manual and in the Pontis Bridge Inspection Pocket Manual.

This research project, however, will develop a more comprehensive set of guidelines and procedures for bridge rehabilitation techniques. WisDOT's current practices will be documented and augmented with best practices and innovative techniques from other states and countries with similar climates.

All of the information on various types of bridge deterioration and alternative techniques for repair will be brought together in a searchable database with complementary diagnostic software.

This electronic bridge repair guide will be compiled in a compact disk (CD) format and illustrated with photographs, drawings and engineering details. Pros and cons, and cost estimates, of the various rehabilitation techniques will be included.

Finally, the investigators will conduct laboratory testing to evaluate promising new repair techniques, such as fiber-reinforced polymer composites (FRP) forms for repair of impact-damaged beams.

## What is the WHRP?

Formed in 1998, the WHRP is a partnership between WisDOT, industry and academia to promote *hard highway research* in Wisconsin.

Investigators from all state universities compete to work on projects in four main areas—rigid pavement, flexible pavement, structures and geotechnics.

Each area has a technical oversight committee (TOC) composed of partner representatives that makes recommendations to the WHRP Steering Committee and monitors the projects.

UW-Madison's College of Civil and Environmental Engineering helps administer the program, with Professor Peter Bosscher serving as WHRP director and ex-officio member of each TOC.

## Flexible Pavement Technical Oversight Committee



**Len Makowski**  
TOC Chair

Members: Tom Brokaw, WisDOT; Judie Ryan, WisDOT; Wes Shemwell, FHWA; Tom Amon, B.R. Amon and Sons; Erv Dukatz, Mathy Construction; Jack Weigel, Payne and Dolan; Hussain Bahia, UW-Madison; Jim Crovetti, Marquette University; Bob Schmitt, UW-Platteville.

## Different asphalts for different roads

Title: *Guidelines for PG binder selection in Wisconsin* (0092-01-01)

Principal Investigator: Hussain Bahia, UW-Madison

Start-end date: November 2000-March 2003 (29 months)

Cost of research: \$99,828

(Note: The number of projects approved for each TOC varies from year to year, but the cumulative dollar amounts are kept approximately the same for each TOC.)

This research project will help WisDOT and contractors select the most appropriate asphalt binder grade for optimum performance of the pavement in a particular location in the state under projected traffic conditions.

### Tailored to temperatures and traffic

Depending on the properties of the asphalt binder, a pavement constructed with it may perform fine in an area with mild summer temperatures but become unacceptably soft in warmer areas, possibly leading to rutting. Likewise, a particular binder may perform well in a temperate winter climate but tend toward cracking under prolonged severe cold conditions.

Traffic volumes and speeds also have an impact on binder performance. High volumes of heavy truck traffic, especially if the trucks are frequently stopping and starting or turning, create additional frictional heating *in the pavement*. This may require pavement made with a different asphalt binder grade than a roadway more subject to higher-speed, lower-weight traffic.

### AASHTO MP1 specification

Ten critical temperature-related properties of asphalt binders were identified during the SHRP Superpave research effort, and laboratory tests were developed to measure them. Maximum and minimum specifica-

tions on the ten tests were defined in 1994 by the American Association of State Highway and Transportation Officials as AASHTO MP1 Specification for PG Binders.

Each "performance grade" is defined by two numbers, such as PG 58-28, the interim WisDOT requirement

### It's all about Superpave™

The three research projects recommended by the WHRP Flexible Pavement TOC for FFY 2001 funding are aimed at continuing the development of Superpave™ technology for Wisconsin roads.

Superpave, which is a trademark of FHWA's Strategic Highway Research Program (SHRP), stands for Superior Performing Asphalt Pavements. These new pavements were made possible by a \$50 million SHRP effort from 1987 to 1993 to advance understanding of asphalt pavement design, testing and performance.

The application of quality assurance (QA) principles such as statistical process control (SPC) to hot mix asphalt (HMA) production was a critical factor in the development of Superpave. Improved control of the physical and chemical properties of asphalt pavement components—sand and gravel (aggregate) and petroleum asphalt—led to the improved pavement performance of Superpave.

WisDOT, in partnership with the Wisconsin Asphalt Pavement Association (WAPA), was a national leader in introducing QA to asphalt pavement construction in 1992 with the state's LV, MV, HV mix specifications (low-volume traffic, medium-volume, high-volume). This was accomplished well before the conclusion and application of the national SHRP research.

The strong WisDOT/WAPA partnership continues to make Wisconsin a leader in advanced asphalt pavement design and construction.

for low-volume rural roads. The first number identifies the temperature, in degrees Celsius, at which various high-temperature performance tests will be conducted; the second number identifies in *minus* degrees Celsius the temperature at which several low-temperature tests will be conducted. Thus, binders classified as PG 58-28 must meet performance tests at 58°C (136°F) and -28°C (-18.4°F).



*Rural roads require different asphalt PG binders than urban highways.*

### Applying the spec in Wisconsin

This research project will develop guidelines to help WisDOT and its partners narrow the wide range of grades in AASHTO MP-1 to those that are most appropriate for Wisconsin roads and climates and that are readily available from regional refineries.

Objectives of this research project include: (1) A review of the most recent regional and national guidelines and trends in PG binder selection and supply. (2) Evaluation in the laboratory of potential grades for use in Wisconsin. Certified asphalt suppliers will be invited to submit samples. Results will be compiled in a Wisconsin PG Binders Properties Database. (3) Development of PG Binder guidelines for Wisconsin, including state maps showing roads, typical temperatures, traffic volumes and traffic speeds.



## Two tests in one

Title: *Using the Gyratory Compactor to Measure Mechanical Stability of Asphalt Mixtures* (0092-01-02)

Principal Investigator: Hussain Bahia, UW-Madison

Start-end date: November 2000-April 2002 (18 months)

Cost of research: \$55,337

This research project will build on SHRP development of a new laboratory test instrument called the gyratory compactor. In this test a newly mixed asphalt-aggregate sample is placed in a steel mold and slowly compacted by a ram while the mold revolves and simultaneously tilts slightly from side to side. The resulting “gyratory” force on the mix simulates the kneading action of rollers used in the paving process.

The gyratory compactor test is a key component of Superpave specifications, since it provides a uniform and field-simulating procedure for compacting mixes of pavement specimens. After compaction in the test device, specimens are measured for properties such as density and air voids, which are critical to long term pavement performance.

### Another use for the Gyratory Compactor

This research project proposes to explore the possibility of obtaining an additional measured value from the asphalt mix sample during compaction—the property of internal friction or mechanical stability. At present, no simple quality control test is in place to reliably measure this property.

The investigator has conducted preliminary research using a simple *shear plate accessory* to the gyratory compactor for measuring mix properties at both initial stages of compaction (loose) and at low air voids (compacted) which simulate conditions under traffic. Preliminary results are encouraging. Ultimate success could have a significant impact nationally.



*Gyratory compactor mold with shear plate accessory for measuring mechanical stability of asphalt mixes.*

Objectives of this research project include collecting asphalt mixes of known performance levels (good and poor) from Wisconsin contractors and testing them for mechanical stability with the new method to establish repeatability of the test and correlation with the field.

## Water and oil ...

Title: *Evaluation of the Extent of HMA Moisture Damage in Wisconsin as it Relates to Pavement Performance* (0092-01-03)

Principal Investigator: Hussain Bahia, UW-Madison

Start-end date: November 2000-April 2002 (18 months)

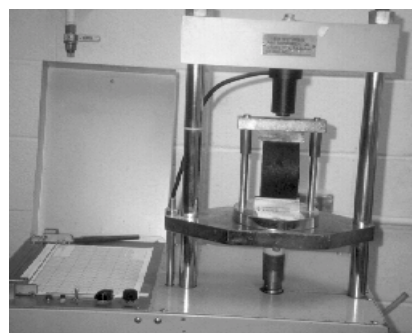
Cost of research: \$50,753

This research project follows up on a larger study completed in 1999 (0092-45-94) which examined the complex question of (1) how excess amounts of moisture in the asphalt mix can lead to pavement performance problems such as stripping or rutting; and (2) whether the current laboratory test to predict moisture-caused problems is effective.

The laboratory moisture screening procedure currently used by Wisconsin and many other states is called the Tensile Strength Ratio (TSR) test. It is a part of Superpave specifications. A standard laboratory machine is used to compare the strength of “wet” and “dry” compacted asphalt.

In the early 1990s, if the TSR of the wet specimen fell below 70% of the dry specimen, WisDOT required contractors to add anti-stripping agents to their mixes, chemicals which improve adhesion of the asphalt binder to the aggregate. This added cost to the project.

However, the 1999 WisDOT study found a number of repeatability and field correlation problems with the TSR test and questioned whether moisture damage had ever been a serious problem in Wisconsin or, if it had been, whether it may have been eliminated by recent mixture and aggregate requirements.



*Tensile strength test device for Tensile Strength Ratio (TSR)*

The Flexible Pavement TOC identified it as a “high priority” to resolve some of these outstanding questions with this project:

(1) Conduct a field study of asphalt pavements built before and after the TSR test requirement was put into effect to quantify the extent of any stripping problem in Wisconsin.

(2) Correlate moisture-caused pavement problems with TSR results to determine the test’s usefulness.

(3) Establish a record of anti-strip additive use in Wisconsin and the costs associated with their use and with required TSR testing.

(4) Recommend modification of the TSR test or use of other criteria.



## Rigid Pavement Technical Oversight Committee



**David  
Larson**  
TOC  
Chair

Members: Tom Lorfeld, WisDOT; Jim Parry, WisDOT; Bob Serak, WisDOT; Wes Shemwell, FHWA; Bill Cape, James Cape and Sons Co.; Mike Maples, Vinton Construction Co.; Kevin McMullen, Wisconsin Concrete Pavement Association; Tom Wenzel, Marquette University; Steve Cramer, UW-Madison; Tim Bolwerk, OMNNI Associates, Inc.

### It's done—why can't we drive on it?

Title: *Early Opening of Portland Cement Concrete Pavements to Traffic* (0092-01-04)

Investigators: James Croveti and Thomas Wenzel, Marquette University

Start-end dates: November 2000-April 2002 (18 months)

Cost of research: \$58,648

While most of us appreciate the renovation of old, deteriorated roads, we don't like the inconvenience of the process. Whether we're property owners along the reconstruction or just highway users, we want the road rebuilt and reopened as quickly as possible.

In the case of rigid pavement, the newly reconstructed road may appear to be complete—equipment and crew are gone, concrete looks dry and hard—but the orange barrels still keep us out. This is, of course, for good reason, since the process of hydration

and strength gain is time and temperature dependent and normally requires from three to seven days before the concrete is strong enough to carry traffic.

Current WisDOT specifications require that a new Portland Cement Concrete (PCC) pavement achieve a minimum compressive strength of 3,000 psi before opening to traffic.

This limit, based on strength requirements for interstate highways, is set to assure protection from premature cracking or reduced service life from too-heavy loads on fresh concrete.

To know when the pavement has reached this minimum strength, several test cylinders of the concrete are cast at the job site at the same time the pavement is poured. These cylinders are then subjected to compressive strength testing at various intervals.

If testing verifies that the pavement has reached 3,000 psi, the newly constructed road may be opened to traffic, assuming other necessary work is complete.



*Compressive  
strength  
tester, with  
concrete test  
cylinder in  
place*

### Benefits and costs of early opening

This research project will attempt to quantify potential benefits—and costs—of opening pavements earlier than the typical three to seven days. Allowing early access to cars and other light vehicles, for example,

might be a benefit and not cause pavement damage.

Should different strength requirements be set based on the traffic a given road is expected to handle? For example, should residential streets or shopping center drives have different minimum strength requirements than main arteries?

Does the benefit of early opening justify the potential added cost of traffic enforcement to keep heavy trucks from entering the road? And what about required pavement markings that are normally applied by heavy trucks subject to the 3,000 psi limit?

To explore these and related questions, the investigators will undertake several tasks:

1. Review national and international pavement specifications and conduct a literature review to establish the state-of-practice for traffic opening criteria. Emphasis will be placed on identifying costs to users from delayed opening, pavement damage caused by early opening, and long-term performance of early opened pavements. Wisconsin contractors will also be surveyed to identify industry issues.
2. Conduct a detailed analysis of PCC pavement systems, using the finite-element computer program ISLAB2000 and other performance prediction models, to evaluate the effects of early-age loadings on pavements.
3. Obtain and test a variety of representative concrete samples from at least six construction sites during the 2001 season. Samples will be tested to simulate early opening and full curing conditions. The investigators will use these results in conjunction with their analysis of PCC pavement systems to assess the full impact of early-age loadings on expected pavement performance.

## Geotechnics Technical Oversight Committee



**Bob Arndorfer**  
TOC  
Chair

Members: Bruce Pfister, WisDOT; Ken Hanzel WisDOT; Tom Strock, FHWA; Harry Lindberg, Wisconsin Earth Movers Association; Tuncer Edil, UW-Madison; Sam Helwany, UW-Milwaukee; Eric Bahner, STS Consultants

### Measuring soil strength prior to paving

Title: *Investigation of the Dynamic Cone Penetrometer (DCP) and Soil Stiffness Gauge (SSG) as Alternative Methods to Determine Subgrade Stability* (0092-01-05)

Investigators: Tuncer B. Edil and Craig H. Benson, University of Wisconsin-Madison

Start-end dates: November 2000-October 2002 (24 months)

Cost of research: \$58,803

It's easy to forget that roads are made of much more than the surface pavement we see and drive on. In reality, it takes several layers of support, working together as a *system*, to assure a smooth, long-lasting roadway.

The *subgrade* or soil on which the pavement rests is the subject of this research project. The subgrade is overlaid with a *base* layer composed of gravel or crushed stone. Occasionally a less expensive sand *subbase* layer is used between the subgrade and base layer. The *surface* pavement layer, composed of asphalt or concrete, overlays the base and completes the road system.

Making sure the soil subgrade is uniformly *compacted* and stable is important to the quality of the final road product. Compaction is achieved by driving heavy construction equipment and/or rollers over the subgrade. Insufficient compaction may leave soft or unstable spots in the soil that can later lead to surface cracking and premature deterioration of the pavement.

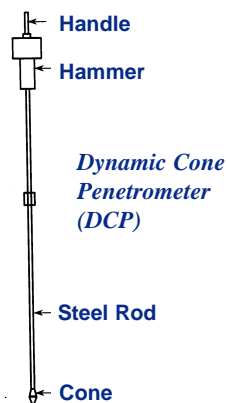
As an added challenge, many Wisconsin soils contain clay or silt, making them more difficult to compact well when wet. Contractors sometimes add fill materials such as fly ash or geosynthetic fabrics and stone to these soils to improve their compaction characteristics.

Measuring the uniform stability of compacted soils and any added materials is a major challenge. Methods that have been traditionally used include moisture-density tests and visual inspection while construction equipment is driving on the subgrade. Both are *indirect* measures of soil strength or stiffness, and the latter can be quite subjective.

### Direct measures of subgrade strength

In this project, the investigators propose to examine approaches for *directly* measuring

soil strength, with particular attention given to two devices currently in use. The first of these, the dynamic cone penetrometer (DCP), consists of a three-to-four-foot steel rod with a cone end that is driven into the subgrade by an 8-kg weight dropped from a height of 575 mm.



The number of blows and depth of penetration of the rod at each blow are recorded. The relationship between the two is calculated to give a dynamic cone penetration index or ratio (DPI). The test can be carried out relatively quickly at different spot locations around the construction site.

The second device to be evaluated is the soil stiffness gauge (SSG), developed by FHWA in partnership with several private companies.



**Soil Stiffness Gauge (SSG)**

The SSG places a load on the subgrade through a vibrating ring and automatically calculates the stiffness (ratio of force to displacement) at that location. One measurement takes about 1.5 minutes.

In this research, the investigators will undertake three tasks:

1. Review and evaluate all existing methods for determining subgrade stability including, besides the DCP and SSG, the falling weight deflectometer (FWD), the portable seismic pavement analyzer (PSPA) and spectral analysis of surface waves (SASW).

2. Characterize the effectiveness and limitations of the DCP and SSG using reference samples of sand, clay and aggregate and representative Wisconsin soils.

3. Deploy the DCP and SSG as part of a WisDOT field demonstration project testing several different subgrade compositions.

## Highway Pooled Fund Projects

### **Improving the asphalt density test**

Title: *Bulk Specific Gravity Round Robin Using the Corelok Vacuum Sealing Device*

Submitted by: WHRP Flexible Pavement TOC

Duration of project: 1 year

Wisconsin contribution: \$10,000

Contact: FHWA

**S**uperpave research showed that the density of hot mix asphalt (HMA) pavement must be carefully controlled. This project is aimed at improving the accuracy and repeatability of the specific gravity test used to determine density.

Participating laboratories will each test 42 HMA samples using an automated vacuum sealing device. The National Center for Asphalt Technology (NCAT) will prepare the samples and compile the data from the round robin.

### **Quick and easy soil stiffness test**

Title: *Non-nuclear Testing of Soils and Granular Bases Using the GeoGauge (Soil Stiffness Gauge)*

Submitted by: WHRP Geotechnical TOC

Duration of project: 2 years

Wisconsin contribution: \$12,000/year

Contact: FHWA

**T**he GeoGauge is the result of a redesign of a military device for locating buried land mines. Through its use of acoustic and seismic detectors, it can directly and quickly determine soil stiffness (resistance to deformation) and subgrade stability.

The device may eliminate the need for the nuclear density test, which requires extensive safety precautions and record keeping.

Wisconsin's participation in this pooled fund project will be coordi-

nated by the WHRP Geotechnical TOC so as to eliminate potential duplication of work being carried out in the TOC's FFY 2001 project.

### **Year-round road construction?**

Title: *Extending the Season for Concrete Construction and Repair*

Submitted by: WHRP Rigid Pavement TOC

Duration of project: 3 years

Wisconsin contribution: \$20,000/year

Contact: Army Corps of Engineers

**P**ouring concrete for roads pretty much ends when temperatures are at 40°F or below, when the material is difficult to work with, cures too slowly, and has lowered strength and long-term durability.

What if a relatively inexpensive, readily available "antifreeze" could be added to the concrete that would permit cold weather concrete pavement construction? This project, led by the Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) proposes to develop just such a technology.

### **Getting 75 years out of concrete blocks**

Title: *Determining the Durability of Modular Retaining Wall Blocks*

Submitted by: WHRP Geotechnics TOC

Duration of project: 30 months

Wisconsin contribution: \$20,000/year

Contact: State of Wisconsin

**W**hile the design life of retaining walls constructed from modular concrete blocks is 75 years, Wisconsin, Minnesota and Illinois have observed premature deterioration of the blocks, possibly caused by salt spray and freeze/thaw cycles.

This project will develop accelerated lab test methods to predict long term durability of the blocks.

### **Dealing with deep soft ground**

Title: *Development of In Situ Deep Stabilization of Soft Ground*

Submitted by: WHRP Geotechnics TOC

Duration of project: Three years

Wisconsin Contribution: \$20,000/year

Contact: FHWA

**F**irst used in the upper midwest in 1997 along Lake Parkway in Milwaukee, "deep mixing" of soft underground soils with hardening slurries or powders has been shown to control settlement.

This project will develop a standard laboratory modulus/strength test that will correlate more closely to the underground *in situ* modulus/strength than do currently used compression tests.

## Ernie Wittwer is new director of the Midwest University Transportation Center (UTC)

After serving the Wisconsin Department of Transportation for 23 years, most recently as administrator of the Division of Transportation Investment Management (DTIM), Ernie Wittwer takes on a new challenge as director of the Midwest University Transportation Center (UTC) based at UW-Madison.

Under the leadership of Interim UTC Director Jeffrey Russell, and with the strong support of WisDOT, UW-Madison formed a consortium of the region's universities and colleges to win the five-year UTC designation from the U.S. Department of Transportation.

Forging a plan for wisely investing the \$4.5 million in federal funding and an equal amount from participating states is one of Wittwer's first objectives.

As UTC director, he will lead research, education and technology transfer efforts focused on the theme Optimization of Transportation Investment and Operations.

"This is a real opportunity to build genuine interstate cooperation in addressing problems we all have," Wittwer said the week before assuming his new duties on November 1.

"We don't want to reinvent the research wheel. We want to pool our



**Ernie Wittwer,  
Midwest  
UTC  
Director**

understanding and our resources to tackle what's really needed and currently not known."

The UTC Executive Committee will meet in December to adopt an action agenda for 2001 and beyond.

"If we can tap, even slightly, the tremendous brain power in the participating academic institutions, and harness it to solve some of our problems," Wittwer concluded, "we will have been successful in this effort."

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Marquette  
University

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Cincinnati

Lac Courte Oreilles  
Ojibwa Comm. College

Richard J. Daley  
Comm. College

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